PATENT SPECIFICATION

763,368

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COMPLETE SPECIFICATION.

Improvements relating to the Coating of Steel Strip or the like.

We, BARROW STEEL WORKS LIMITED, a British Company, of Walney Road, Barrow-in-Furness, Lancashire, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to the provision of rust-resisting coatings on steel in strip or sheet form. The invention is primarily applicable to, and will be described in detail in connection with, strip of the kind used as ties for bales of cotton. The formation of rust on such ties stains the cotton to such an extent that rust marks show themselves in cloth woven from the cotton, and there is an unsatisfied demand for rust-resistant ties.

To be satisfactory, a rust-resistant coating must cover the whole surface, must not crack or flake off when the tie is bent round the bale of cotton and passed through the usual buckle, and must not be oily or sticky. Moreover, it must not be very expensive.

Now the strip used as ties is commonly hot-rolled from billets and forms oxide scale during the rolling and cooling. Even though the strip may pass through a descaling device before passing through the finishing rolls, it must be descaled and thoroughly cleaned before any paint or chemical coating can be applied, thus introducing additional manufacturing steps as well as the cost of the paint or chemicals used; and in extensive experiments no such coating has been found capable of withstanding the bending of the ties without suffering some damage.

According to this invention both faces of steel strip or sheet are sprayed with zinc before more than incipient scale can form on them after the strip or sheet emerges from the finishing rolls. The steel is, of course, hot, and the sprayed zinc appears to bite into and bond with the hot faces to provide a protective skin which is found to withstand bending of the strip or sheet excellently.

The temperature of the strip at the time of spraying is important. It must be high enough for the pass through the finishing rolls to take place without excessive wear on the rolls, and for the finished strip to move easily along the usual trough which it enters from the finishing rolls. This means that it must not be below 800° C. when it leaves the finishing rolls, On the other hand the temperature should not be too high because then the zinc fumes and becomes burnt. It is found that the temperature must not exceed 900° C., and at that temperature some fuming of the zinc takes place. It is preferred to avoid any fuming and to keep the temperature below 850° C.

The most suitable temperature for the strip at the moment of spraying is about 820°.

All the temperatures referred to above are determined by optical pyrometry, and temperatures given in the claims hereof are to be construed accordingly.

The invention will be more clearly understood by reference to the accompanying drawings, in which:

Figure 1 is a diagram of one plant;

Figure 2 shows the arrangement of the finishing rolls and spraying apparatus on a larger scale; and

Figure 3 is an end view of the spraying apparatus.

Figure 1 shows a strip-rolling mill comprising four roll stands, 1 to 4, and a finishing roll stand 5, all these comprising pairs of rolls. A hot billet is passed six times through rolls in the stand 1 and then once through the rolls of the stand 2. It is next passed through the rolls of the stand 3 and

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emerges from them as a flexible length, which is immediately introduced into the rolls of the stand 4. On emerging from these rolls, the length, now resembling strip but not yet of the required section, tends to form into zig-zag shape on a support 6. The free end of the strip is passed through a descaling device 7 to the finishing rolls 5. The descaling device 7 consists of two bars 10 and 11, the strip passing under the bar 10 into a narrow gap between the bars and then over the bar 11 so that each surface is scraped during the passage of the strip through the device. The bar 10 is raised to allow the end of the strip to be inserted and is then moved downwards into contact with the strip, being raised again when the whole strip has passed. From the finishing rolls the strip emerges at very high speed, say 1200 feet per minute, into a long trough 9, ultimately coming to a halt in this trough and being removed from it by tongs. The mill so far described is of conventional construction.

In the invention, a metal-spraying apparatus 12 is provided about eight feet from the rolls 5 and comprises eight spray guns 13A to 13H carried by a frame 14. This frame surrounds the trough 9, the base of which is removed throughout the target area of the guns. The four guns 13A to 13D are mounted above the strip travelling through the trough and the four guns 13E to 13H below it. In the top set of four guns, two (13A and 13B) are directed at the side edges of the strip and two (13C and 13D) at its upper face, these two guns being spaced apart in the direction of travel of the strip so that the strip is struck by sprayed metal from first the gun 13C and then the gun 13D. The guns below the strip are similarly arranged. This arrangement of the guns above and below the strip ensures that all the surfaces of the strip are coated. All the guns can be adjusted in position on the frame 14.

The guns are of the conventional kind in which powdered zinc is blown by compressed air through a flame, say of propane burning in oxygen. The total thickness of the zinc coating on each face of the strip may advantageously be about one half thousandth of an inch, and the feed of metal to the guns is adjusted accordingly. Alternatively, the guns may be fed with zinc rod, which is atomised in them.

Now if very considerable wear on the rolls is to be avoided the temperature during rolling must be high, as indicated above, and indeed the strip usually leaves the finishing rolls at about 930 to 940° C. It is not feasible to allow the strip to travel some distance along the trough 9 and in so doing to cool from this high temperature before it is sprayed, since then scale forms and the sprayed zinc coating breaks away from the strip when the latter is bent. In view of the very high speed at which the strip moves in the trough 9 it travels a considerable distance away from the rolls 5 in a very short time. Even at this speed it is essential to ensure that the sprayed metal strikes the strip before it has travelled more than a few feet from the rolls 5, as otherwise enough scale is formed on the strip to interfere with the proper adhesion of the metal coating. There is therefore a real difficulty in carrying out the process satisfactorily.

One way of overcoming this difficulty and ensuring that the strip is rolled hot with minimum wear on the rolls and yet at the right temperature for spraying it to cool it with water as it travels through the space between the finishing rolls 5 and the spraying apparatus 12. Figures 1 and 2 show a water-cooling device 8 for spraying jets of water onto the travelling strip. Some of the water collects in the trough 9 below the spraying device and forms a pool or bath through which the strip passes and by which it is additionally cooled.

Another way of ensuring that the strip is at the right temperature for spraying with zinc is to hold it for a few seconds on the support 6 so as to cool it to, say, 900° C. before it enters the finishing rolls.

The distance between the finishing rolls 5 and the spraying apparatus 12 need not be exactly eight feet, but the spraying with both cooling water and metal must take place before more than incipient scale can form. In general this means that the zinc must strike all the surfaces of the strip not later than half a second after they leave the rolls 5. Some scale must begin to form during the travel of the strip from the finishing rolls to the spraying apparatus, but it appears that the zinc penetrates or mixes with the scale to form a firmly adherent coating.

The operation of the spray guns may be controlled automatically. For instance the movement of the bar 10 may be caused to open and close contacts in an electric circuit through which the operation of the spray guns is controlled, so that metal will be sprayed only when strip is about to enter and is passing through the finishing rolls, and will stop directly the descaling device 7 is opened after the passage of the strip through it.

The coated strip may be cut into lengths to form cotton ties in the usual way, and the final product will be a zinc-coated cotton tie.

If steel sheet is being coated instead of strip, enough spray guns must be used to ensure that the whole area of each surface of the sheet is effectively coated.

What we claim is:—

1. A method of producing coated steel strip which comprises hot-rolling a billet to strip by passage through successive pairs of rolls, the strip emerging from the finishing rolls at a temperature over 900° C., cooling the strip to a temperature between 800 and 900° C. and spraying both faces of the strip with zinc after the cooling, the spraying and cooling taking place immediately after the strip leaves the finishing rolls.

2. A method of producing coated steel strip which comprises hot-rolling a steel billet to strip by passage through successive pairs of rolls, descaling the strip as it enters the finishing rolls, and spraying all the surfaces of the strip with zinc before more than incipient scale can form on them after the strip emerges from the finishing rolls and while it is at a temperature between 800 and 850° C.

3. A method of producing coated steel strip which comprises hot-rolling a billet to strip by passage through successive pairs of rolls, descaling the strip as it enters the finishing rolls, the strip emerging from the finishing rolls at a temperature over 900° C., spraying the strip with water to cool it to a temperature between 800 and 900° C., and spraying all the surfaces of the strip with zinc while it is at this temperature, all the spraying taking place before more than incipient scale can form on the strip.

4. A method according to Claim 1, substantially as described with reference to the accompanying diagrammatic drawings.

5. Zinc-coated steel strip produced by a method according to any of the preceding claims.

6. Cotton ties cut from strip according to Claim 5.

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PROVISIONAL SPECIFICATION.

Improvements relating to the Coating of Steel Strip or the like.

We, BARROW STEEL WORKS LIMITED, a British Company, of Walney Road, Barrow-in-Furness, Lancashire, do hereby declare this invention to be described in the following statement:—

This invention relates to the provision of rust-resistant coatings on steel in strip or sheet form. The invention is primarily applicable to, and will be described in detail in connection with, strip of the kind used as ties for bales of cotton. The formation of rust on such ties stains the cotton to such an extent that rust marks show themstlves in cloth woven from the cotton, and there is an unsatisfied demand for rust-resistant ties.

To be satisfactory, a rust-resistant coating must cover the whole surface, must not crack or flake off when the tie is bent round the bale of cotton and passed through the usual buckle, and must not be oily or sticky. Moreover, it must not be very expensive.

Now the strip used as ties is commonly hot-rolled from billets and forms oxide scale during the rolling and cooling. Even though the strip may pass through a descaling device before passing through the finishing rolls, it must be descaled and thoroughly cleaned before any paint or chemical coating can be applied, thus introducing additional manufacturing steps as well as the cost of the paint or chemicals used: and in extensive experiments no such coating has been found capable of withstanding the bending of the ties without suffering some damage.

According to this invention both surfaces of steel strip are sprayed with zinc or aluminium immediately after the strip emerges from the finishing rolls. The steel is, of course, hot, and the sprayed metal appears to bite into and bond with the hot surface to provide a protective skin which is found to withstand bending of the strip excellently.

Zinc is the preferred sprayed metal, and the temperature of the strip at the time of spraying is important. It should not be too high because then the zinc fumes and becomes burnt. On the other hand it must be high enough for the pass through the finishing rolls to take place without excessive wear on the rolls, and for the finished strip to move easily along the usual trough into which it is delivered by the finishing rolls. A temperature of about 800° C. is satisfactory. It is not feasible to roll at a higher temerature and allow the strip to cool before it is sprayed, since then scale forms and the sprayed zinc coating breaks away from the strip when the latter is bent.

In a modern rolling mill the strip leaving the finishing rolls travels at a very high speed, say 1200 feet per minute, and therefore moves a considerable distance away from the rolls in a very short time. Even at this speed it is essential to ensure that the sprayed metal strikes the strip before it has travelled more than a few feet from the rolls, as otherwise enough scale is formed

on the strip to interfere with the proper adhesion of the metal coating.

The metal may be sprayed through guns of the conventional kind in which powdered metal is blown by compressed air through a flame, say of propane burning in oxygen. Preferably metal is sprayed onto each surface through more than one spray gun. For example, six guns may be used, three on each side of the strip, the coating on each side thus consisting of three successive layers. The total thickness of each coating may advantageously be about one half thousandth of an inch, and the feed of metal to the guns is adjusted accordingly. Alternatively, the guns may be fed with zinc rod, which is atomised in them.

The battery of guns is housed in a casing through which the strip passes, provision being made for recovering and reusing the sprayed metal which does not strike the strip.

In view of the importance of freedom from scale, the strip should be passed through a descaling device before passing through the finishing rolls. This may consist, as usual, of two bars, the strip passing under one into a narrow gap between them and then over the other, so that each surface is scraped during the passage of the strip through the device. In a device of this kind, one bar is moved into its operative position to engage the leading end of the strip. Advantageously the movement of this bar may be caused to open and close contacts in an electric circuit through which the operation of the spray guns is controlled, so that metal will be sprayed only when strip is about to enter and is passing through the finishing rolls, and will stop directly the descaling device is opened after the passage of the strip through it.

The coated strip may be cut into lengths to form cotton ties in the usual way, and the final product will then be a zinc-coated cotton tie. This is believed to be a new article of manufacture and is itself a feature of the invention.

If steel sheet is being coated instead of strip, enough spray guns must be used to ensure that the whole area of each surface of the sheet is effectively coated.

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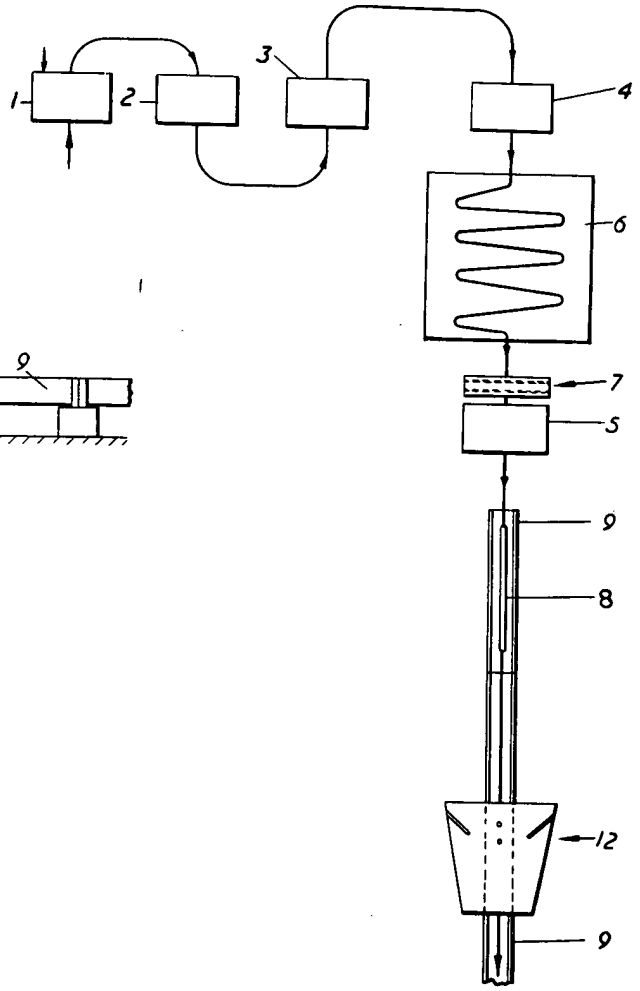
1 SHEET This drawing is a reproduction of the Original on a reduced scale

FIG. 1.



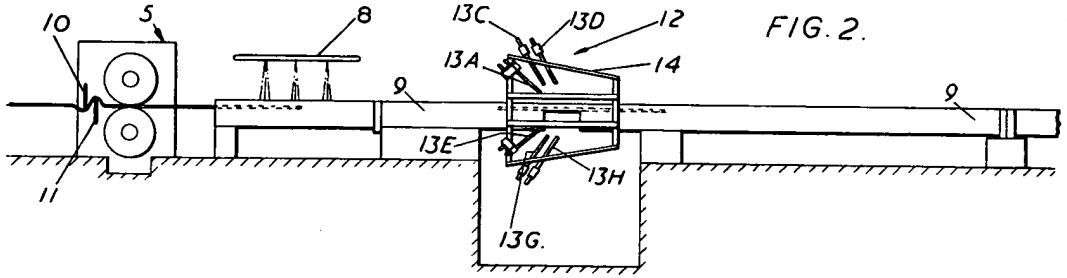


FIG. 2.

FIG. 3.